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13. ABSTRACT *(Maximum 200 words)*

The conference on Interaction Between Operator Theory, Wavelet Theory and Control Theory, was held May 1-2, 1993 in Charlotte NC. The event was organized and hosted by the University of North Carolina at Charlotte. The main purpose of the Conference was to bring researchers together, in so doing, to encourage an interchange of information and stimulation of cooperative efforts.

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Scientific Report on Grant F49620-93-1-01800DEF

The "Conference on Interaction between Operator Theory, Wavelet Theory and Control Theory" was held May 1-2, 1993 in Charlotte, NC. The event was organized and hosted by the University of North Carolina at Charlotte. Funding for the conference was provided by AFOSR & NSA ($ 8,140) and UNCC ($ 2,000). There were thirty participants registered for the Conference. The main purpose of the Conference was:

> To bring researchers together, in so doing, to encourage an interchange of information and stimulation of cooperative efforts.

In my judgement this goal was achieved. We have four well known mathematicians to give one hour talks. We also have other 17 twenty minute talks.

- This is the first mathematical conference which emphasizes on the interactions between operator theory, wavelet theory and control theory.
- The four invited speakers are the following.
  - Charles K. Chui of Texas A&M University. (wavelet analysis, spline functions, linear systems and control, and approximation theory.)
    Title: *Affine Operators and Wavelet-Frames.*
  - Ciprian Foias of Indiana University.($\mathcal{H}^\infty$-control,operator theory,operator algebras and functional analysis.)
    Title: *On the Minimum Delay Characterization of Outer Functions and of Maximum Entropy.*
  - David R. Larson of Texas A&M University. (non-self adjoint operator algebra,wavelet theory.)
    Title: *An Operator Theoretic Approach to Some Aspects of Wavelet Theory.*
  - Victor Wickerhauser of Washington University. (R. Coifman suggested for substitution of him.) (wavelet theory)
    Title:*The Adapted Waveform Functional Calculus.*

- Twenty minute speakers include: Debao Chen (the University of Texas-Austin), Victor Kaftal (the University of Cincinnati), Keith Coates (Texas A&M University), Jianrong Wang (the University of Pittsburgh), Caixing Gu (Indiana University), Warren Wogen (the University of North Carolina), Joseph Ball (VPI&SU), Weibang Gong and Deguang Han (Qufu Normal University, China), Minjun Lai (the University of Georgia), Chris Brislawn (Los Alamos National Laboratory), Michael Dritschel (College of William and Mary), Lifeng Ding (Georgia State University), Mang Fai Ma (the University of Pittsburgh), M.Bakonyi (Georgia State University), Wei Cai and J.Wang (UNCC and TAMU), Xin Li (the University of Nevada-Las Vagas), Elias Katsoulis (the East Carolina State University).

- Near one hundred people showed interest in attending the conference. Due to bad timing (final exam for most of universities and conflicting with some other conferences), many mathematicians could not come. These include: Ronald Coifman (Yale University), William Helton (UC San Diego), Charles R. Johnson (College of William and Mary), Guy Battle (Texas A&M University), Bagget (University of Colorado), Jon Sjogren (AFOSR/NM), Edward Seff (University of South Florida), Ronald DeVore and B. Jarworth (University of South Columbia), Paul Muhly and Palle Jorgensen (the University of Iowa).

Topics of the talks covered included interactions between operator theory and wavelet theory, interactions between operator theory and control theory,constructions of new wavelets, operator theory and operator algebras and, wavelet theory and its applications to signal processing, to solution of PDE (For details see the enclosed program).

From my point of view it has been clearly demonstrated at the Conference operator theory and operator algebras provided and will provide essential contribution into applied mathematics including wavelet theory and control theory.

Xingde Dai

Principal Investigator

Program Schedule of the Conference on the Interaction Between Operator Theory, Wavelet Theory and Control Theory

Department of Mathematics, UNC-Charlotte sponsored by AFOSR, NSA and UNCC

Location: 110 Architecture Bldg. (ARCH 110) on the campus of UNCC

May 1, 1993

8 : 00 – 4 : 00	Registration
9 : 00 – 9 : 15	Opening
9 : 15 – 10 : 05	*C.K. Chui, Texas A&M University* *Affine Operators and Wavelet – frames*
10 : 15 – 10 : 35	*Debao Chen, the University of Texas – Austin* *Extended families of spline wavelets*
10 : 45 – 11 : 05	*Victor Kaftal, the University of Cincinnati* *Joint Norm Control Results and Questions*
11 : 15 – 11 : 35	*Keith Coates, Texas A&M University* *Elementary operators and subalgebras*
11 : 45 – 12 : 05	*Jianrong Wang, the University of Pittsburgh* *Wavelet and Dilation Equations*
12 : 15 – 2 : 00	Lunch Break

2 : 00 – 2 : 50 *Ciprian Foias, Indiana University*
On the minimum delay characterization of outer functions and of maximum entropy

3 : 00 – 3 : 20 *Caixing Gu, Indiana University*
The optimal and suboptimal solutions of mixed sensitivity problems

3 : 30 – 3 : 50 *Warren Wogen, the University of North Carolina*
Semi–Cross Product

4 : 00 – 4 : 20 *Joseph Ball, VPI & SU*
Factorization, interpolation and feedback stabilization for non linear system

4 : 30 – 4 : 50 *Weibang Gong and Deguang Han, Qufu Normal University*
Spectrum of product of operators and compact perturbation

5 : 00 – 7 : 30 Dinner Break

7 : 30 – 7 : 50 *Minjun Lai, the University of Georgia*
On Stromberg's Wavelets

8 : 00 – 8 : 20 *Chris Brislawn, Los Alamos National Laboratory*
Wavelet Galerkin Approximation for Distributed Parameter Control Systems

8 : 30 – 8 : 50 *Murali Rao, the University of Florida*
Scaling functions with support in [-1,1]

May 2, 1993

9 : 00 -- 9 : 50 *M. Victor Wickerhauser, Washington University*
The adapted waveform functional calculus

10 : 00 -- 10 : 20 *Palle Jorgensen, the University of Iowa*
TBA

10 : 30 – 10 : 50 *Michael Dritschel, College of William and Mary*
Commutant Lifting on Krein Spaces when the Intertwining Operator is not Necessarily a Contraction

11 : 00 – 11 : 20 *Lifeng Ding, Georgia State University*
A reflexivity result and its applications

11 : 30 – 11 : 50 *Mang Fai Ma, the University of Pittsburgh*
Smoothness of scaling functions

12 : 00 – 2 : 00 Lunch Break

2 : 00 – 2 : 50 *David Larson, Texas A&M University*
An Operator -- Theoretic Approach to Some Aspects of Wavelet Theory

3 : 00 – 3 : 20 *M. Bakonyi, Georgia State University*
Several remarks on joint norm extension

3 : 30 – 3 : 50 *W. Cai and J. Wang, UNCC and TAMU*
Wavelet collocation method for nonlinear time evolution – PDE's

4 : 00 – 4 : 20 *Xin Li, the University of Nevada – Las Vagas*
Wavelet decomposition ofbivariate functions

4 : 30 – 4 : 50 *Elias Katsoulis, the East Carolina State University*
Some results on the unit ball of a nest algebra

Affine Operators and Frames of Multivariate Wavelets[1]

Charles K. Chui and Xianliang Shi[2]
Center for Approximation Theory
Texas A&M University
College Station, TX 77843

Abstract. The objective of this paper is to generalize some of our earlier one-variable results on affine (frame) operators and (wavelet) frames to the multi-variable setting, by considering dilation (or scaling) matrices A, not necessarily of the form $2I_s$, where I_s is the s-dimensional identity matrix. In particular, if $A = \lambda U$ for some $\lambda > 1$ and unitary matrix U, then under certain mild decay and smoothness conditions on a finite collection of generating functions, it is proved that these functions generate a class of L^2-bounded affine operators if and only if each of these functions has zero mean. As an application of this result, the first oversampling theorem is established. More precisely, under the same conditions on the dilation matrix A and the generating functions, if these functions generate a frame of $L^2(\mathbb{R}^s)$, $s \geq 1$, then for any positive integer n, n-times oversampling of this frame does not destroy the frame.

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[2]Permanent Address of the second author: Department of Mathematics, Hangzhou University, Hangzhou, China.

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On the minimum delay characterization of outer functions and of maximum entropy interpolants

by C. Foias (Indiana University)

A simple but very striking characterization of the scalar outer functions was found a long time ago by E.A. Robinson. Namely they are the transfer functions which, among all the functions with the same power spectrum, achieve the minimum delay in transferring energy. This characterization easily extends to a large class of operator-valued functions. Inspired by Robinson's characterization, we have found a similar minimum delay characterization for the central intertwining dilation in the Commutant Lifting Theorem. Since this last theorem provides a unifying frame for many classic and modern interpolation problems, the minimum delay characterization provides a new useful characterization of all maximum entropy interpolants in all the Nehari and Nevanlinna-Pick problems occurring in Systems Theory. In particular, by using that characterization, we proved a long standing conjecture concerning the permanency property of the maximum entropy interpolants in the Nevanlinna-Pick problem.

This work was done jointly by the lecturer with A.E. Frazho (Purdue University) and I. Gohberg (Tel Aviv University).

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"The adapted waveform functional calculus"

·M. Victor Wickerhauser
· Operator Theory and Control Theory
UNCC, 1--2 May 1993

We will describe the expansion of a function in new libraries of waveforms (wavelets, wavelet packets, localized sines, etc.) which are well-adapted in the sense that the expansion requires a very small number of terms even though the expansion elements are generic and easy to describe. We will discuss applications to problems of control theory, including the detection of transients in noise, filtering, and lowering the complexity of matrix multiplication. These results are a survey of work by Beylkin, Coifman, Donoho, Mallat, Meyer, Rokhlin and many others.

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Operators and Wavelets I

By Xingde Dai[1]
University of North Carolina at Charlotte
and
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Texas A&M University

Abstract

We investigate the structure of the set $\mathcal{W}(D,T)$ of *all* orthogonal wavelets for the translation and dilation operators T and D acting on complex $\mathcal{L}^2(\mathbf{R})$. The set $\mathcal{W}(D,T)$ is parameterized in terms of a fixed orthogonal wavelet ψ and the set $\mathcal{U}_\psi(D,T)$ of unitary operators U which satisfy a local commutation relation. An analysis of the structure of $\mathcal{U}_\psi(D,T)$ yields information concerning $\mathcal{W}(D,T)$.

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